

IN THE CLAIMS:

- 1 1. (Withdrawn) A direct methanol fuel cell system comprising:
2 an anode, a cathode, and a membrane electrolyte disposed between the anode and
3 cathode;
4 a source of air or oxygen coupled to the cathode;
5 a source of methanol;
6 a source of water;
7 a detector for detecting changes in an output power level of said fuel cell; and
8 a methanol concentration regulator coupled to the methanol source, detector and
9 anode, said regulator responsive to changes in output power level of said cell for varying
10 the concentration of said methanol at said anode such that cross-over of methanol through
11 said membrane electrolyte is substantially minimized over a dynamic operating range.

- 1 2. (Withdrawn) The fuel cell system as in claim 1 wherein said concentration
2 regulator is constructed using microelectromechanical system (MEMS) fabrication tech-
3 niques.

- 1 3. (Withdrawn) The fuel cell system as in claim 2 wherein said concentration
2 regulator comprises a microactuator mechanically coupled to said anode and operable in
3 response to said detector to increase or decrease a flow of methanol to said anode.

- 1 4. (Withdrawn) The fuel cell system as in claim 3 wherein said microactuator
2 comprises an enclosed chamber mechanically coupled to a flow plate which supplies
3 methanol to said anode, said chamber being filled with a control liquid in which a resis-
4 tive element is disposed, said resistive element operable in response to said detector to
5 heat said liquid and thereby exert pressure on said flow plate.

- 1 5. (Withdrawn) The fuel cell system as in claim 2 wherein said concentration
2 regulator comprises a microactuator which is integrated with said anode.
- 1 6. (Withdrawn) The fuel cell system as in claim 2 wherein said concentration
2 regulator comprises a microactuator mechanically coupled to a gas diffusion layer and
3 operable in response to said detector to increase or decrease a flow of methanol to said
4 anode.
- 1 7. (Withdrawn) The fuel cell system as in claim 2 wherein said concentration
2 regulator comprises a microactuator integrated with a gas diffusion layer and operable in
3 response to said detector to increase or decrease a flow of methanol to said anode.
- 1 8. (Withdrawn) The fuel cell system as in claim 1 wherein said concentration
2 regulator is constructed using non-MEMS fabrication techniques.
- 1 9. (Withdrawn) The fuel cell system as in claim 1 wherein said concentration
2 regulator is constructed using a combination of MEMS and non-MEMS fabrication tech-
3 niques.
- 1 10. (Currently Amended) A method of regulating a concentration of methanol in a
2 direct methanol fuel cell system, the system including a direct methanol fuel cell being
3 used to provide power to an application device, comprising the steps of:
4 using a detector to sense changes in an output power level of said fuel cell and producing
5 a signal indicative of said changes; and
6 using said signal to drive a concentration regulator which responsively controls
7 the amount of methanol supplied to said fuel cell's anode in response to changes
8 sensed in said output power level.

1 11. (Original) The method as in claim 10 wherein said concentration regulator is
2 constructed using MEMS fabrication techniques.

1 12. (Currently Amended) [[The method as in claim 11 wherein]] A method of regu-
2 lating a concentration of methanol in a direct methanol fuel cell system, including a direct
3 methanol fuel cell, comprising the steps of:
4 using a detector to sense changes in an output power level of said fuel cell and producing
5 a signal indicative of said changes; and using said signal to drive a concentration regula-
6 tor which responsively controls the amount of methanol supplied to said fuel cell's anode
7 in response to changes sensed in said output power level, said concentration regulator
8 [[comprises]] comprising a microactuator mechanically coupled to said anode and oper-
9 able in response to said detector to increase or decrease a flow of methanol to said anode.

1 13. (Original) The method as in claim 12 wherein said microactuator comprises
2 an enclosed chamber mechanically coupled to a flow plate which supplies methanol to
3 said anode, said chamber being filled with a control liquid in which a resistive element is
4 disposed, said resistive element operable in response to said detector to heat said liquid
5 and thereby exert pressure on said flow plate, whereby the flow of methanol to said anode
6 is varied.

1 14. (Currently Amended) The method as in claim [[11]] 12 wherein said concentra-
2 tion regulator comprises a microactuator integrated with said anode.

1 15. (Currently Amended) The method as in claim [[11]] 12 wherein said concentra-
2 tion regulator comprises a microactuator mechanically coupled to a gas diffusion layer
3 and operable in response to said detector to increase or decrease a flow of methanol to
4 said anode.

- 1 16. (Currently Amended) The method as in claim [[11]] 12 wherein said concentra-
2 tion regulator comprises a microactuator integrated with a gas diffusion layer and oper-
3 able in response to said detector to increase or decrease a flow of methanol to said anode.
- 1 17. (Original) The method as in claim 10 wherein said concentration regulator is
2 constructed using non-MEMS fabrication techniques.
- 1 18. (Original) The method as in claim 10 wherein said concentration regulator is
2 constructed using a combination of MEMS and non-MEMS fabrication techniques.
- 1 19. (Withdrawn) A direct methanol fuel cell system comprising:
2 an anode, a cathode, and a membrane electrolyte disposed between the anode and
3 cathode;
4 a source of air or oxygen coupled to the cathode;
5 a source of methanol;
6 a source of water; and
7 a methanol concentration regulator, coupled to the methanol source and anode, re-
8 sponsive to changes in a potential at said anode for varying the concentration of said
9 methanol at said anode such that cross-over of methanol through said membrane electro-
10 lyte is substantially minimized over a dynamic operating range.
- 1 20. (Withdrawn) The fuel cell system as in claim 19 wherein said concentration
2 regulator is constructed using microelectromechanical system (MEMS) fabrication tech-
3 niques.
- 1 21. (Withdrawn) The fuel cell system as in claim 20 wherein said concentration
2 regulator comprises a microactuator mechanically and electrically coupled to said anode.
- 1 22. (Withdrawn) The fuel cell system as in claim 21 wherein said microactuator
2 comprises an enclosed chamber mechanically coupled to a flow plate which supplies

3 methanol to said anode, said chamber being filled with a control liquid in which a resis-
4 tive element is disposed, said resistive element operable in response to said detector to
5 heat said liquid and thereby exert pressure on said flow plate.

1 23. (Withdrawn) The fuel cell system as in claim 20 wherein said concentration
2 regulator comprises a microactuator which is integrated with said anode.

1 24. (Withdrawn) The fuel cell system as in claim 20 wherein said concentration
2 regulator comprises a microactuator mechanically coupled to a gas diffusion layer and
3 operable in response to said detector to increase or decrease a flow of methanol to said
4 anode.

1 25. (Withdrawn) The fuel cell system as in claim 20 wherein said concentration
2 regulator comprises a microactuator integrated with a gas diffusion layer and operable in
3 response to said detector to increase or decrease a flow of methanol to said anode.

1 26. (Withdrawn) The fuel cell system as in claim 19 wherein said concentration
2 regulator is constructed using non-MEMS fabrication techniques.

1 27. (Withdrawn) The fuel cell system as in claim 19 wherein said concentration
2 regulator is constructed using a combination of MEMS and non-MEMS fabrication tech-
3 niques.

1 28. (Currently Amended) A method of regulating a concentration of fuel in a direct
2 oxidation fuel cell system, including a direct oxidation fuel cell being used to pro-
3 vide power to an application device, comprising the steps of:
4 sensing changes in potential at an anode or load level of said fuel cell system; and
5 using said sensed changes in potential to drive a concentration regulator which re-
6 sponsively controls the amount of [[methanol]] fuel supplied to said fuel cell's

7 anode when said power level increases and decreases, thereby minimizing cross-
8 over of [[methanol]] fuel through said fuel cell's membrane electrolyte.

1 29. (Original) The method as in claim 28 wherein said concentration regulator is
2 constructed using MEMS fabrication techniques.

1 30. (Currently Amended) [[The method as in claim 29 wherein]] A method of regu-
2 lating a concentration of fuel in a direct oxidation fuel cell system comprising the
3 steps of:
4 sensing changes in potential at an anode or load level of said fuel cell system; and
5 using said sensed changes in potential to drive a concentration regulator which re-
6 sponsively controls the amount of fuel supplied to said fuel cell's anode when
7 said power level increases and decreases, thereby minimizing cross-over of fuel
8 through said fuel cell's membrane electrolyte, and said concentration regulator
9 [[comprises]] comprising a microactuator mechanically coupled to said anode and
10 operable in response to said detector to increase or decrease a flow of methanol to
11 said anode.

1 31. (Original) The method as in claim 30 wherein said microactuator comprises
2 an enclosed chamber mechanically coupled to a flow plate which supplies methanol to
3 said anode, said chamber being filled with a control liquid in which a resistive element is
4 disposed, said resistive element operable in response to said detector to heat said liquid
5 and thereby exert pressure on said flow plate, whereby the flow of methanol to said anode
6 is varied.

1 32. (Currently Amended) The method as in claim [[28]] 30 wherein said concentra-
2 tion regulator comprises a microactuator integrated with said anode.

1 33. (Currently Amended) The method as in claim [[28]] 30 wherein said concentra-
2 tion regulator comprises a microactuator mechanically coupled to a gas diffusion layer

3 and operable in response to said detector to increase or decrease a flow of methanol to
4 said anode.

1 34. (Currently Amended) The method as in claim [[28]] 30 wherein said concentra-
2 tion regulator comprises a microactuator integrated with a gas diffusion layer and oper-
3 able in response to said detector to increase or decrease a flow of methanol to said anode.

1 35. (Original) The method as in claim 28 wherein said concentration regulator is
2 constructed using non-MEMS fabrication techniques.

1 36. (Original) The method as in claim 28 wherein said concentration regulator is
2 constructed using a combination of MEMS and non-MEMS fabrication techniques.

1 37. (Previously Presented) The method of regulating a concentration of metha-
2 nol in a direct methanol fuel cell system, as defined in claim 10, including the further step
3 of
4 when said detector senses a low output power level of said fuel cell and said con-
5 centration regulator indicates a high concentration of methanol, using said signal to drive
6 said concentration regulator to responsively decrease the amount of methanol supplied to
7 said anode thereby substantially minimizing cross-over of methanol through said fuel
8 cell's membrane electrolyte.

1 38. (Previously Presented) The method of regulating a concentration of metha-
2 nol in a direct methanol fuel cell system, as defined in claim 10, including the further step
3 of
4 when said detector senses a high output power level of said fuel cell and said con-
5 centration regulator indicates a low concentration of methanol, using said signal to drive
6 said concentration regulator to responsively increase the amount of methanol supplied to

7 said anode thereby providing optimal methanol concentration while substantially mini-
8 mizing cross-over of methanol through said fuel cell's membrane electrolyte.

1 39. (Previously Presented) The method of regulating a concentration of metha-
2 nol in a direct methanol fuel cell system as defined in claim 28 including the further step
3 of

4 when a change in said potential of said fuel cell indicates an increase in a high
5 power operating fuel cell, and methanol concentration indicated by said concentration
6 regulator is low, using said signal to drive said concentration regulator to responsively
7 increase the amount of methanol supplied to said fuel cell's anode, to produce an optimal
8 amount of methanol being supplied to said anode, while substantially minimizing metha-
9 nol crossover.

1 40. (Previously Presented) The method of regulating a concentration of metha-
2 nol in a direct methanol fuel cell system as defined in claim 28 including the further step
3 of

4 when a change in said potential of said fuel cell indicates an increase in a
5 low power operating fuel cell, and methanol concentration indicated by said concentra-
6 tion regulator is high, using said signal to drive said concentration regulator to respon-
7 sively decrease the amount of methanol supplied to said fuel cell's anode, to substantially
8 minimize methanol crossover.

1 41. (Withdrawn) A method of regulating a concentration of methanol in a direct
2 methanol fuel cell system comprising the steps of:

3 providing a diffusion layer disposed between said anode and a source of metha-
4 nol; and

5 varying a rate of diffusion of methanol through said diffusion layer, thereby con-
6 trolling a methanol concentration at said anode.

1 42. (Withdrawn) The method as in claim 41 wherein said rate of diffusion is varied
2 by compressing or decompressing said diffusion layer.

1 43. (Withdrawn) The method as in claim 41 wherein said rate of diffusion is varied
2 by changing a porosity of said diffusion layer.

1 44. (Withdrawn) The method as in claim 41 wherein said rate of diffusion is varied
2 by changing a tortuosity of said diffusion layer.